



# ILRS Governing Board Meeting

Riga, Latvia

October 01, 2017; 16:00-18:00

## Agenda

- |  |                                    |        |
|--|------------------------------------|--------|
| • Opening Remarks  | G. Bianco                          | 5 min  |
| • Workshop Overview and Schedule                           | K. Salmins/M. Pearlman             | 10 min |
| • ILRS Report/ILRS Status and Current Topics               | M. Pearlman/C. Noll                | 20 min |
| • Standing Committee/Study Group/Board Briefs              |                                    |        |
| – Analysis SC  | E. Pavlis/C. Luceri                | 5 min  |
| – Missions SC  | T. Otsubo/S. Wetzel                | 5 min  |
| – Data Formats and Procedures SC                           | H. Mueller/R. Ricklefs             | 5 min  |
| – Networks and Engineering SC                              | M. Wilkinson/G. Kirchner           | 5 min  |
| – Transponder SC   | U. Schreiber/J. McGarry, J. Degnan | 5 min  |
| – Space Debris Study Group                                 | G. Kirchner                        | 5 min  |
| – Quality Control Board                                    | M. Pearlman                        | 5 min  |
| • GGOS Activities  | M. Pearlman                        | 5 min  |
| • 21 <sup>st</sup> International Workshop on Laser Ranging | M. Fulton                          | 10 min |
| • Other Business   | G. Bianco                          |        |
| • Election of Appointed GB Members (CLOSED)                | M. Pearlman                        | 20 min |



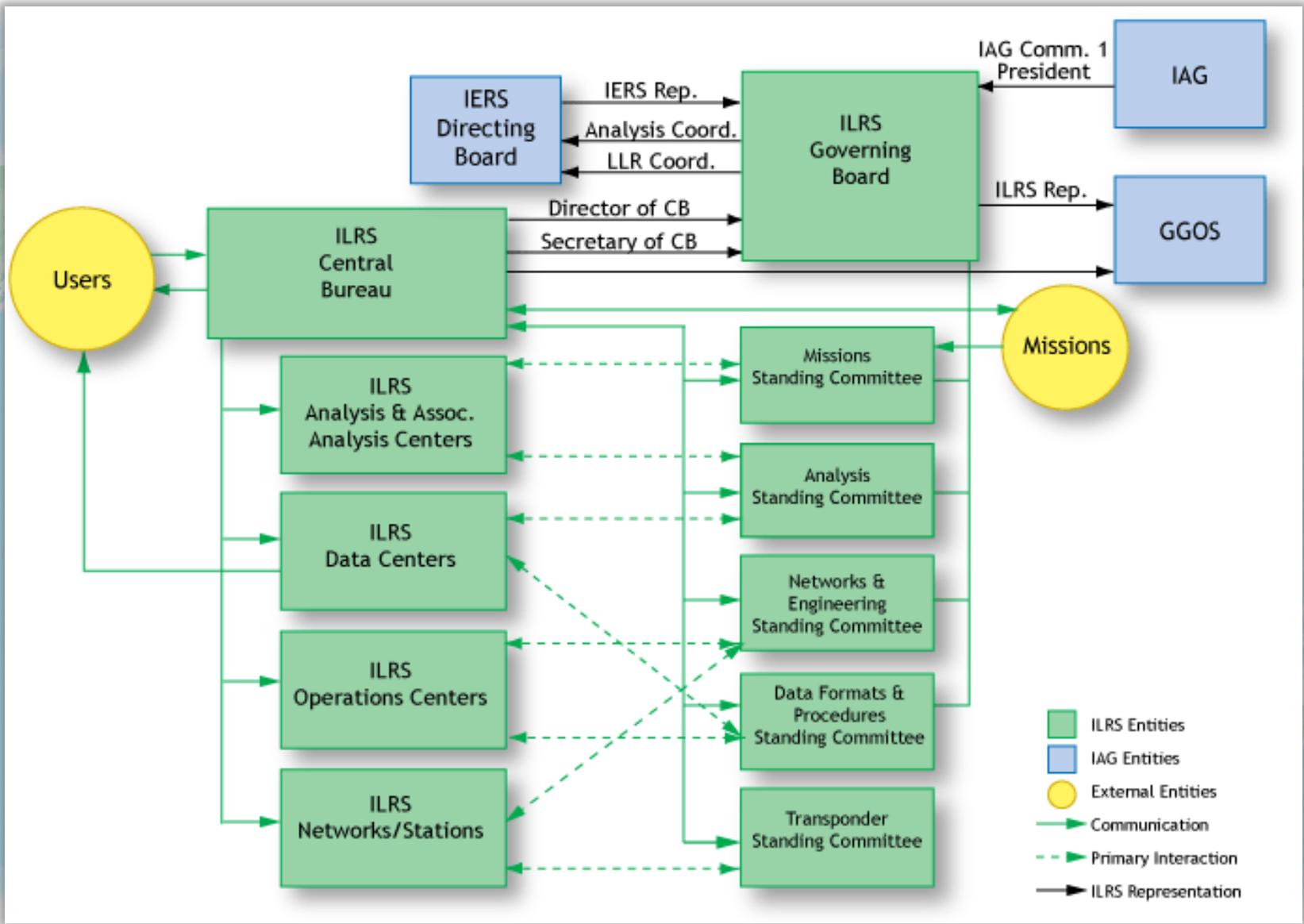
International Laser Ranging Service

# Overview

Michael Pearlman  
Carey Noll  
ILRS Central Bureau

October 01, 2017  
ILRS Governing Board Meeting  
Riga, Latvia

# ILRS organization



# ILRS governing board



Ex officio members:	Michael Pearlman	Director, Central Bureau
	Carey Noll	Secretary, Central Bureau
	Urs Hugentobler	President of IAG Commission 1
Appointed members:	Daniela Thaller	IERS representative to ILRS
	Giuseppe Bianco	Eurolas Network Representative, Chair
	Georg Kirchner	Eurolas Network Representative
	James Bennett	WPLTN Network Representative
	Toshimichi Otsubo	WPLTN Network Representative
	Stephen Merkowitz	NASA Network Representative
	Jan McGarry	NASA Network Representative
Elected members:	Vincenza Luceri	Analysis Center Representative
	Erricos Pavlis	Analysis Center Representative
	Horst Mueller	Data Center Representative
	Ludwig Combrinck	LLR Representative
	Matt Wilkinson	At Large Representative
	Ulrich Schreiber	At Large Representative
Past chairs:	Graham Appleby	2010-2013
	Werner Gurtner	2002-2009
	John Degnan	1998-2001

# ILRS standing committees, study groups



Standing Committee (SC)/Study Group (SG)	Chairs, Co-Chairs
Analysis SC	Erricos Pavlis, Cinzia Luceri
Data Formats and Procedures SC	Horst Mueller, Randy Ricklefs
Missions SC	Toshi Otsubo, Scott Wettzell
Networks and Engineering SC	Matt Wilkinson, Georg Kirchner
Transponder SC	Ulli Schreiber, Jan McGarry/John Degnan
Space Debris SG	Georg Kirchner, Ludwig Grunwaldt

# Recent status and activities (1 of 2)



- Continue to coordinate, develop global standards/specifications and encourage international adherence to its conventions
- Updated of ILRS Terms of Reference completed and approved by IAG; two appointed members added to the Governing Board (to be voted on today!)
- New Station Policy Statement to account for new trends in SLR tracking
  - Defined requirement for an operational vs. engineering station
  - Detailed station responsibilities and requirements
- New ILRS Network Application form includes updates to reflect current capabilities within the ILRS:
  - Includes signature for acknowledging concurrence to the ILRS station policies
  - Station agrees to
    - Range only to satellites that have been authorized by the ILRS and listed on the ILRS website
    - Adhere to the ILRS restricted tracking procedures
    - Keep its site logs and configuration files current
    - Maintain aircraft avoidance and other ILRS safety procedures

# Recent status and activities (2 of 2)



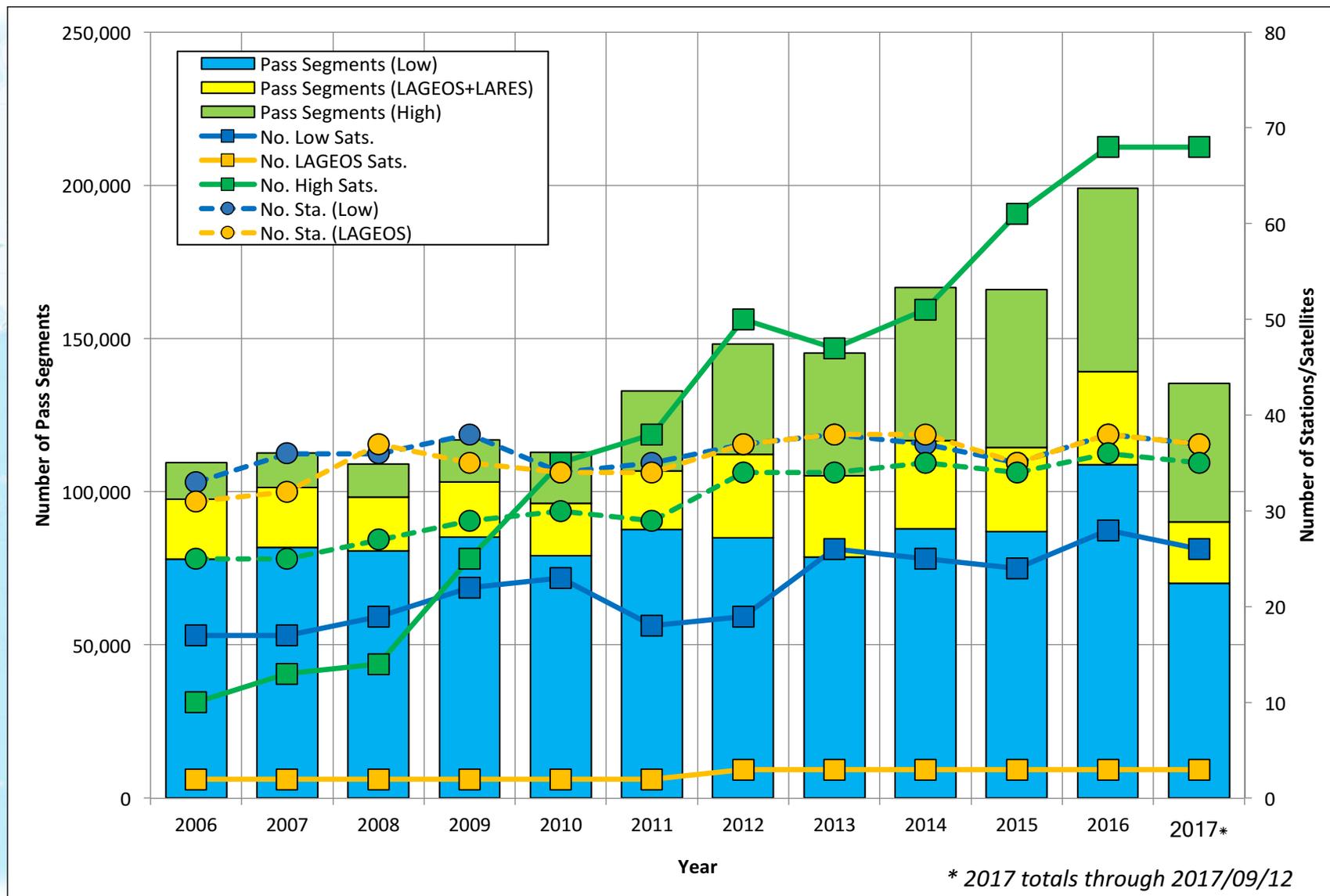
- New data Quality Control Board (QCB) addressing laser ranging data quality issues
  - Data systematics Pilot Project (on line tool to examine data biases)
  - Web-based performance tool based on the inputs to the Report Card
  - On-line Forum Tool
  - Examining NP consistency, benefit of low elevation data, etc.
- Updates to site log format in review; will add more information about station configuration and operation
  - In review with NESC and DFPSC
  - To be discussed during workshop splinter meetings
- New ILRS process for parallel data submission for system configuration updates (e.g., NASA event timer upgrade)
- Examining new strategies to “rate” station performance underscoring value to the users
- New concept in retroreflector designs (LARES-2)

- New systems operational in 2017:
  - DLR: Stuttgart, Germany (engineering station)
  - Russian system: Hartebeesthoek, South Africa
  - KASI: Gamak Mountain, South Korea
- Systems in process (near-term):
  - AGGO in La Plata, Argentina should be operational this year
  - San Juan, Argentina station under repair and upgrade; should be operational late 2017 with kHz ranging
  - Metsahovi, Finland station should be operational in 2018
  - Wuhan, China under repair and upgrade; should be operational late 2017
  - One-meter aperture telescope under development at Wuhan; plans to deploy one of these systems in Xinjian Province in NW China
- New Russian stations enhancing spatial and temporal coverage; discussions underway for stations in Ensenada Mexico, Tahiti, and Indonesia
- NASA SGP plans:
  - Continuing to develop core site in Texas; current schedule has VGOS station installed by 2019 and SGSLR by 2020
  - Recently signed agreement with NMA to deploy an SGSLR to Ny-Ålesund after completion of the Texas station
  - Developing the plans for replacing the rest of the NASA legacy SLR network with SGSLR systems
- Other stations in process/upgrade



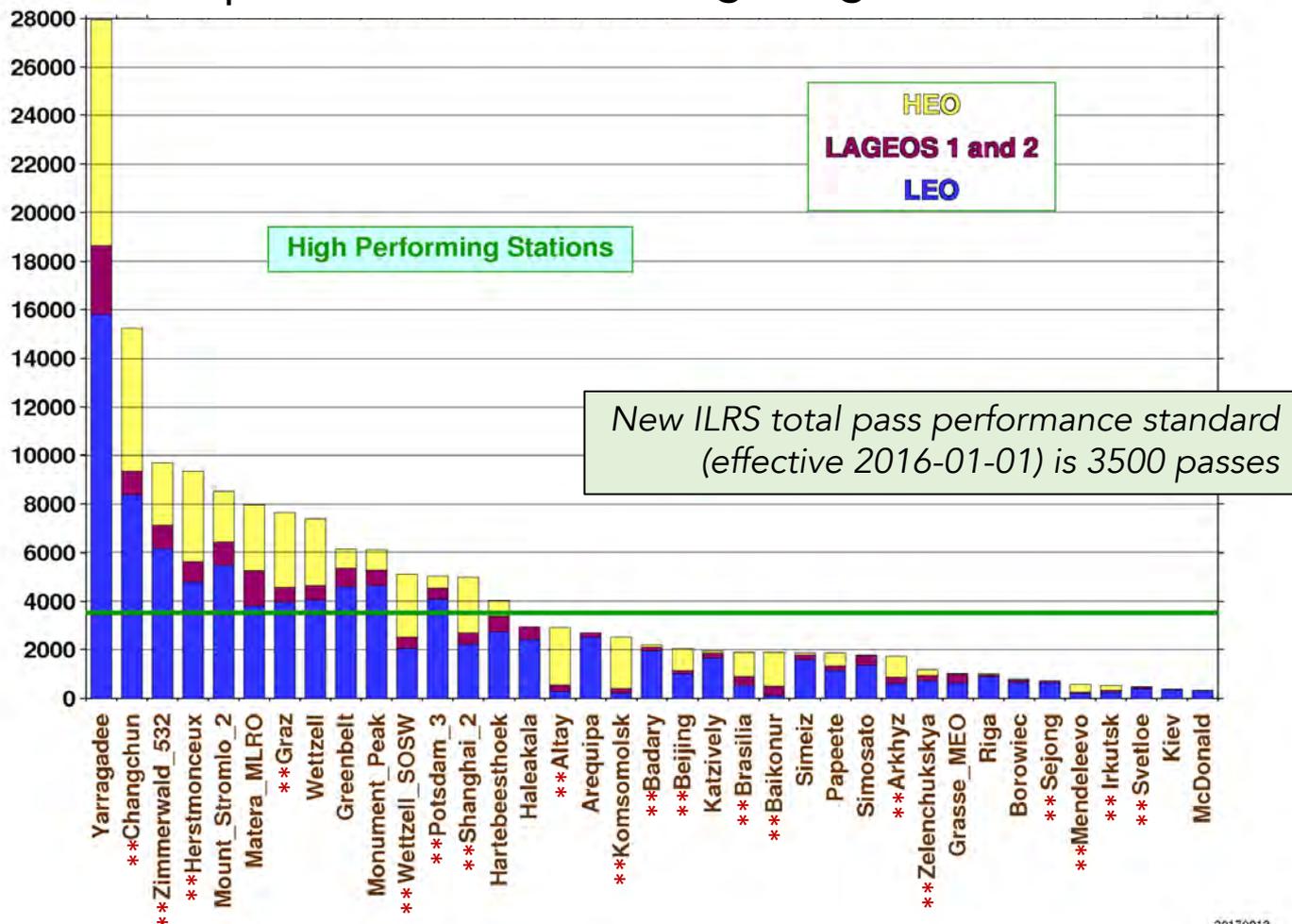
*In spite of the progress, we continue to see large geographic gaps*

# Yearly pass segment totals (by satellite type)



# Network performance (1 of 2)

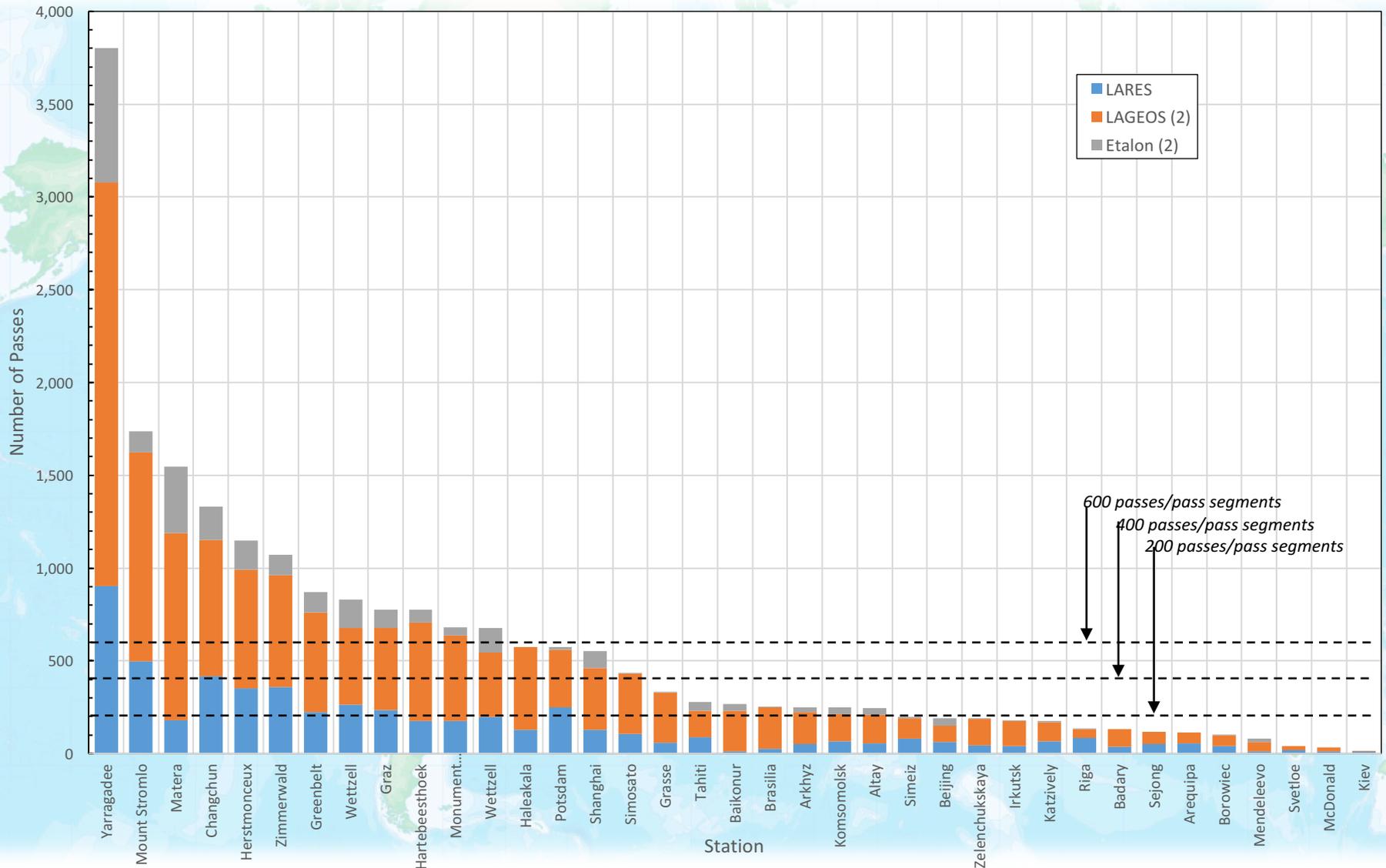
Total Passes  
September 01, 2017 through August 31, 2017



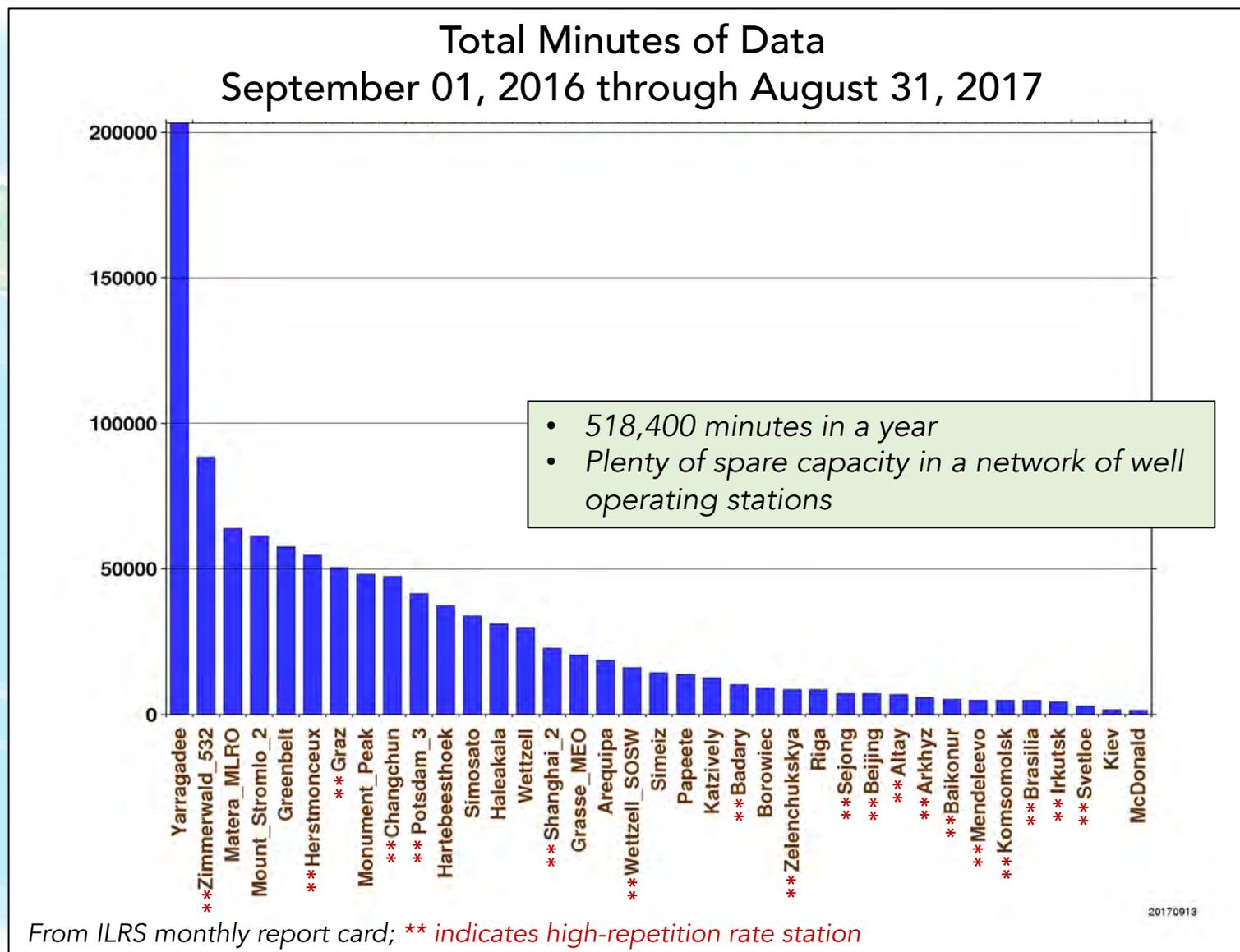
From ILRS monthly report card; \*\* indicates high-repetition rate station

20170913

# Reference frame pass totals

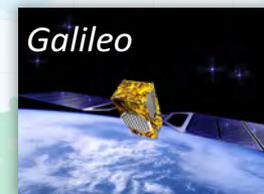


# Network performance (2 of 2)

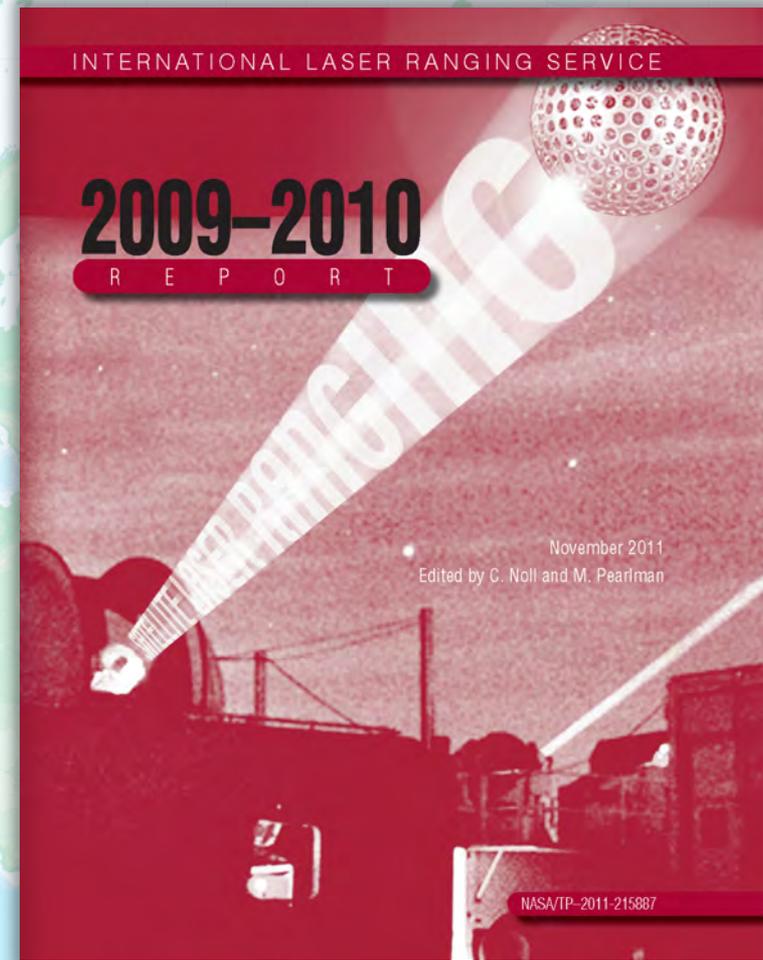


# Mission developments

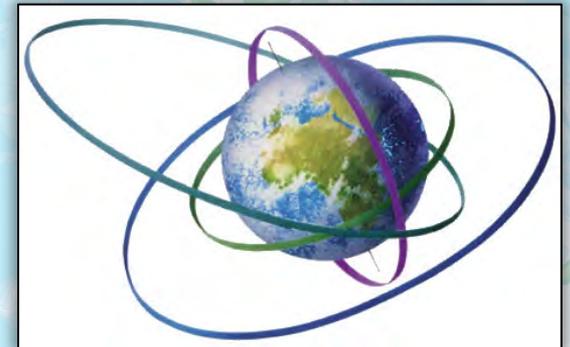
- List of satellites on ILRS tracking roster continues to grow
  - Routinely tracked nearly 100 satellites in 2017 (are we "over saturated?")
- New satellites:
  - Galileo-207, -212, -213, -214 (Mar-2017)
  - QZS-2 (Jun-2017), QZS-3 (Aug-2017)
  - TechnoSat (Jul-2017)
  - S-Net (Dec-2017)
  - Geo-IK-2 (Sep-2017)
- Future missions (approved with MSRs):
  - Additional Beidou/Compass, Galileo, etc.
  - PN constellation (China) (2017?)
  - Sentinel-3B (2017?)
  - GRACE-FO, HY-2C, SWOT, NISAR, COSMIC-2, and IceSat-2
- Past missions:
  - Lomonosov (01/2017); SpinSat (03/2017); IRNSS-1A (08/2017)
- Campaigns:
  - LARGE (mainly GLONASS); Galileo, IRNSS-1B



- ILRS has not produced an (bi-)annual report since the 2009-2010 issue
- Need to resume generation of these reports
- Collection and compilation of the individual component reports is a great deal of work
- Is an on-line only document sufficient for our needs?
- Report summarizes component activities for last (2) years
  - Individual station reports or summary by network (e.g., NASA, Russia, etc.)?



- Increasing global coverage of laser ranging stations; many geographic gaps still exist primarily in Latin America and Africa
- Implementing new systems and upgrades to overcome the present mix of new and old technologies; trying to get more standardization in system hardware and operations
- Improving data quality (reducing system biases) as the ILRS strives for mm accuracy
- Supporting an ever increasing list of targets, many now at GNSS and synchronous altitudes
  - Need to implement more effective tracking strategies
  - Be more selective on the targets
- Supporting new missions in order to contribute to a broader range of scientific and operational applications
- Developing new retroreflector designs to increase range accuracy and signal link





# ILRS Analysis Standing Committee Report

## ILRS Governing Board Meeting

Riga, Latvia,  
October 1, 2017

Erricos C. Pavlis and Cinzia Luceri  
Analysis Coordinators



# ILRS ASC Activities



- **Daily & Weekly** products delivered from six ACs:
  - **ASI** (AC & CC), BKG, DGFI, ESA, GFZ, and **JCET**(AC & CC)
  - Absent temporarily: **NERC (network issues prevent uploads to CDDIS ?)**
  - Absent for over a year: **GRGS...**
  - Finalized the 4-sat orbital product (six ACs are submitting SP3 files, **GRGS & NERC do not participate**)
- The Station Systematic Error Monitoring PP completed the first phase with results from SIX ACs agreeing within the error of the estimates, while **ESA is sometimes an outlier**
  - the only remaining AC to contribute is **GRGS...**
- We had a very successful and productive ASC meeting in Riga, major topics were the CoM correction model update and systematic error monitoring.



# ILRS ASC Future Activities



- PP for systematic error estimation will move to next phase:
  - Reanalyzing of the data since ~2010 will deliver starting error estimates to be adopted in the analysis of current/future data
- Implementation of ITRF2014/SLRF2014 is now complete
- PP for low-degree harmonic estimation and the incorporation of LARES in the operational data product is next in line
- Finally, PP for observational-level modeling of loading corrections for stations and corresponding gravitational corrections in orbit (operational product) [ summer 2018??? ]



# Network Support



- New & old stations validated & accepted in 2017 so far:
  - Riga, Mt. Stromlo, Irkutsk, and Kunming (nearly completed)
  - New S. Korean Geochang site, Tanegashima and new Russian system at Hartebeesthoek are currently in quarantine
- The ASC validated the Yarragadee and Haleakala installation of ET units to replace outdated TIUs; three additional systems are in line next.
- The ASC has reviewed the online site logs and found some issues; working with the appropriate OCs to remedy these asap
  - we need stations to make it a habit to look after their site logs and report corrections/changes!

- **ILRS Annual Report 2016 (ILRS contribution):**
  - It was submitted this summer, under IERS CB review
- **Special Issue on Laser Ranging in the Journal of Geodesy:**
- Abstracts are with Editor in chief
  - We will be notified soon about the date when the official Springer site will open to accept submissions (in about 1-2 weeks)
  - Expecting all submissions by January/February 2018.
- **Future Meetings:**
  - The next Spring meeting of the ASC will take place in Vienna, tentatively on Friday, April 13, the week of EGU 2018



# Missions SC Report

@ ILRS GB Meeting

1 Oct 2017

(SC Meeting: 5 pm, 3 Oct 2017)

Toshimichi Otsubo

and

Scott Wetzel



# Missions SC Meeting Agenda



**(1) Opening/Welcome**

**(2) Membership**

**(3) GGOS Standing Committee on Satellite Missions (J Mueller → Otsubo)**

Under GGOS Bureau of Networks and Observations

**(4) Ongoing/Future Missions (5-10 min each)**

\* TechnoSat (Barschke, TU Berlin)

\* S-NET (Yoon, TU Berlin)

\* OPS-SAT (Kirchner, Graz)

\* Geo-IK-2 (Parkhomenko?)

+ *BLITS-M (Sokolov → Otsubo)*

+ *PAZ and GRACE-FO (Grunwaldt)*

+ *ICESAT-2 (Wetzel + McGarry)*

- Others (?)

**(5) (Future) Updates on the mission webpages esp for GNSS**

**(6) Other issue?**

**(7) Closure**

# CPF and CRD Format Changes

- .Changes for unique mission (ELT)
- .Expanded configuration information for mets, software, camera
- .Correct oversights in original formats
- .Debris tracking will be included to avoid multiple format branches
- .Updates to manuals
- .Schedule:
  - Change/approve this week
  - Finish manuals by end of 2017

# Site Log Format Changes

## •Major additions

- restricted tracking capabilities
  - retain older survey ties as station revise site log
  - more ground target and calibration information and SRP
  - laser, and beam divergence information
  - telescope change date stamps
- New version will be discussed and approved jointly by DF&PSC and NEWSOC at DF&PSC meeting on Monday

# Software Resuse

- .Open sourced UT/MLRS lunar prediction, filtering, and normal point code with NASA permission. Now on ILRS web site
- .Herstmonceaux is open sourcing a Python version of their normal point processor, possibly later this year



# Networks & Engineering SC Meeting

16:00-17:00 Tuesday 3<sup>rd</sup> October (Room 240)

**ILRS Technical Workshop, Riga**

# NESC Agenda

- Networks and Engineering SC Forum
- Summary of updates to the ILRS Site Log
  - presentation by Randy Ricklefs
- SLR tracking of decommissioned ILRS targets
- **Discussion:** Priorities for the NESC

# NESC Forum



- The NESC forum has **73** members
- Other stats:

Total Posts:	62
Total Topics:	24
Total Categories:	4
Total page views:	153459 (???)

- Activity on the forum was very quiet in recent months. It increased in the run up to the Workshop and after email reminders.

# NESC Forum



- How can NESC members increase activity?
  - Invite your colleagues to sign up
  - Think of a new topic of interest and post it
  - Reply to posts
  - **What else??**

# NESC Forum



- Activity should breed more activity and interest, so try to post something. This could be:
  - An update about your station (especially if you've an upgrade underway)
  - A link to a website/report/paper of interest
  - A question to the community
- A new “Photograph Wall” section has just been added

- Summary of updates to the ILRS Site Log
  - presentation by Randy Ricklefs

- SLR tracking of decommissioned ILRS targets

# NESC Priorities

- What should be the top priorities and areas of focus for the Networks and Engineering SC?
- Suggestions:
  - **Systematic Bias.** Building on previous surveys by email and the outcomes from [Workshop Session 3: Accuracy and scheduling](#), could the NESC compile all known potential sources of systematic range error?
  - **New technique development.** Stations are involved in time-transfer, space debris, laser communications etc.
  - **Site surveying.** Is this being carried out by all stations as well as could be?
  - **Greater network collaboration and cooperation.** Is the NESC Forum the best way to support the network? or is there something else we should do?

# Transponder SC

Riga, Oct. 1, 2017

# Activities:

One-way ranging: LRO

Time Transfer: T2L2

upcoming: ACES

There is still a substantial “disconnect” between Laser Com. and SLR despite the fact that there is a huge amount of competence in both communities

Time Transfer is currently the main (only) activity of the Transponder SC.

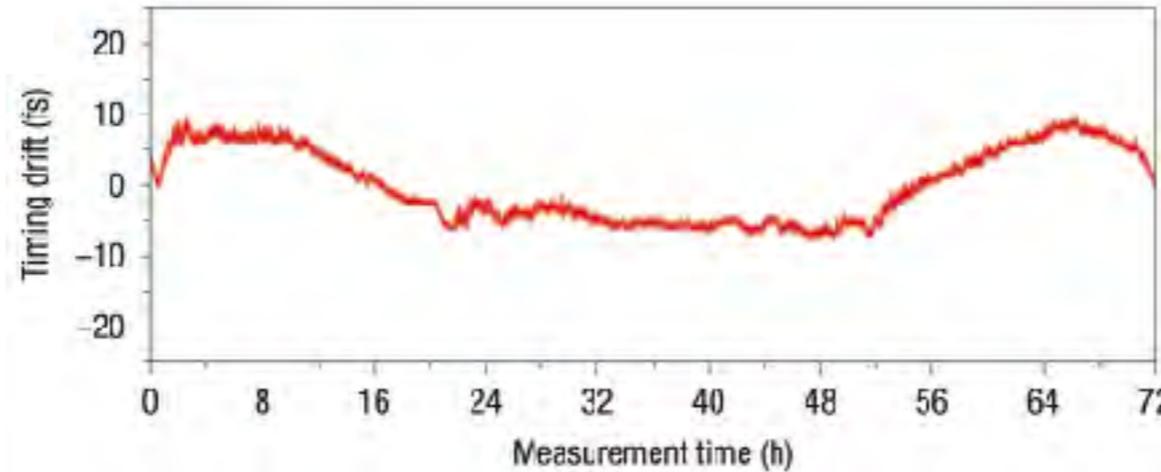
Why should we concentrate on this and what does it for the SLR community?

**Statement:** Time transfer capabilities (local at the station) provides a powerful handle on variable system delays by performing closures

This may solve the "Scale problem" in the ITRF

# Common Clock for Space Geodetic Techniques

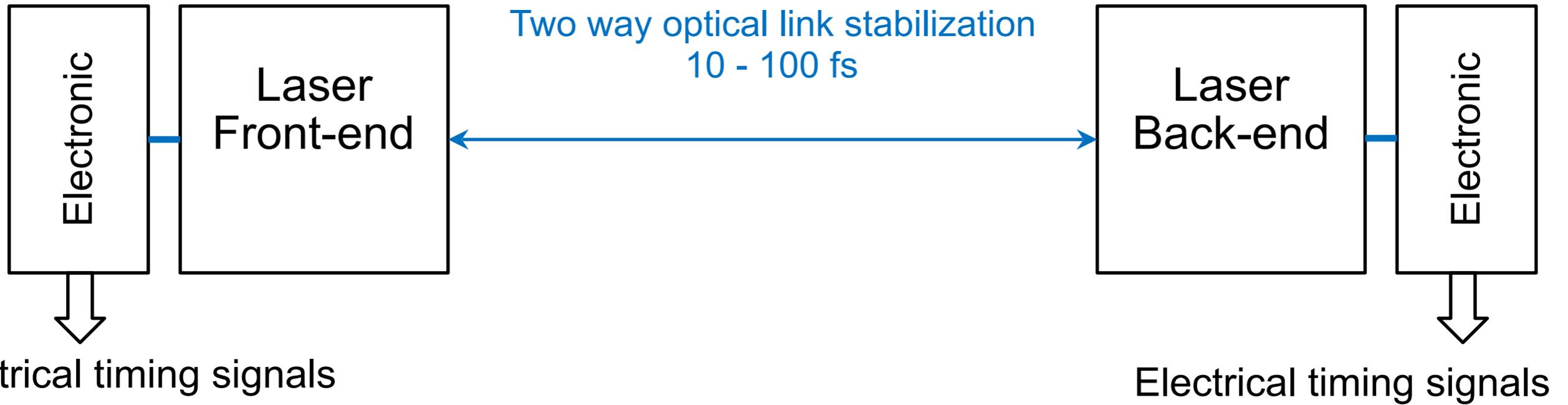
optical cross- correlation of  
2 fiber lines (300 m)



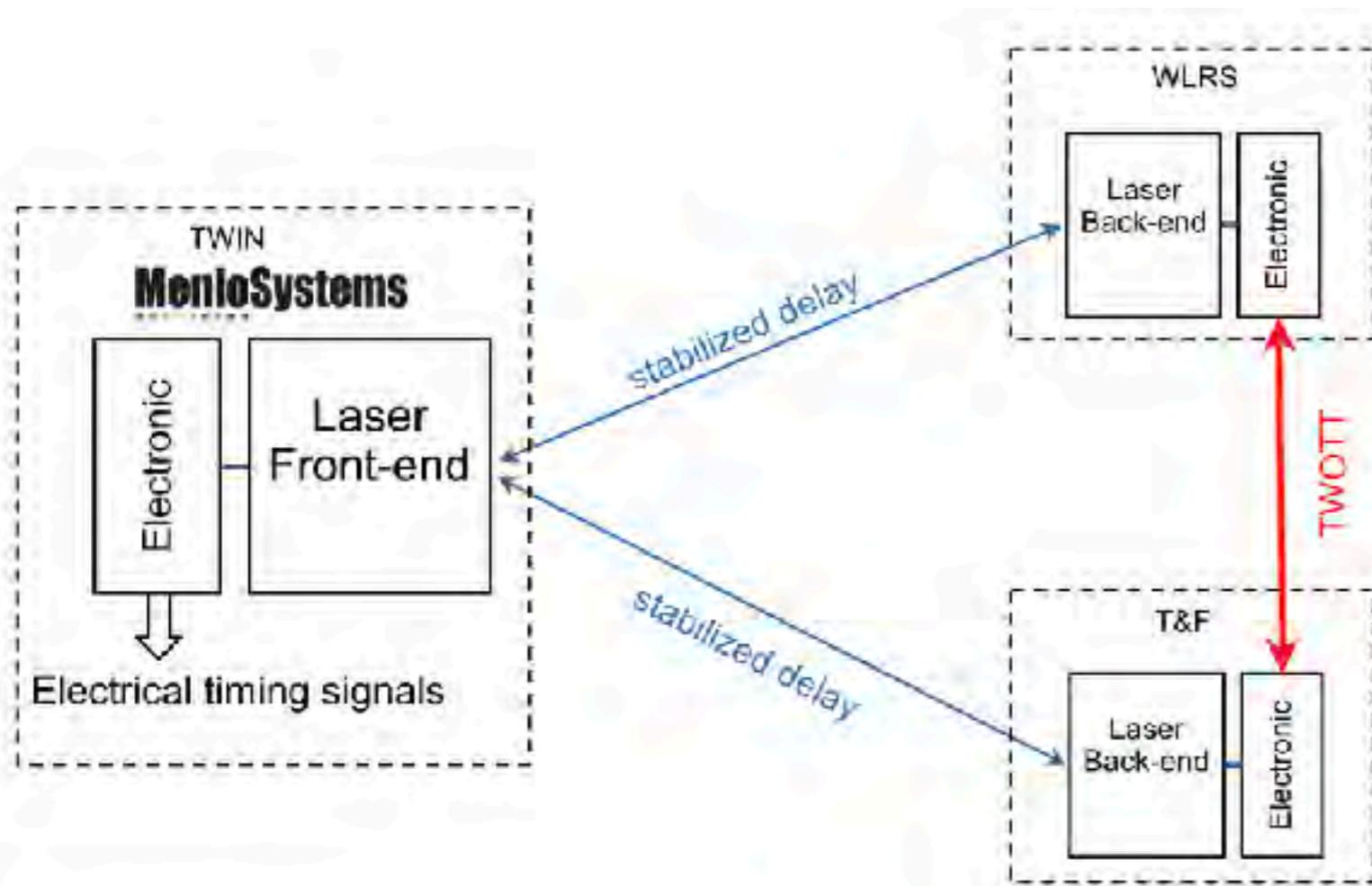
6.4 fs r.m.s.

Kim et al. Nature Photon, **2**(12), 733–736, (2008)

**MenloSystems**

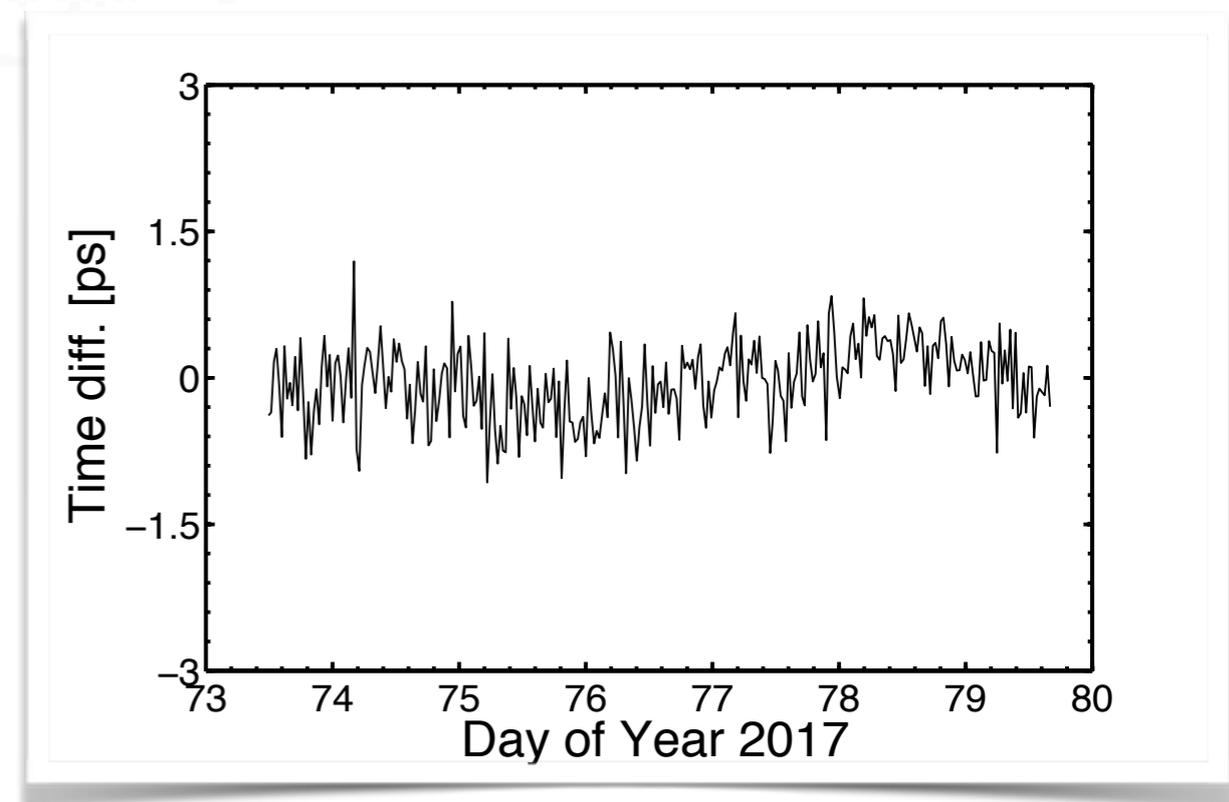


“electrical” Timing stability ~1ps

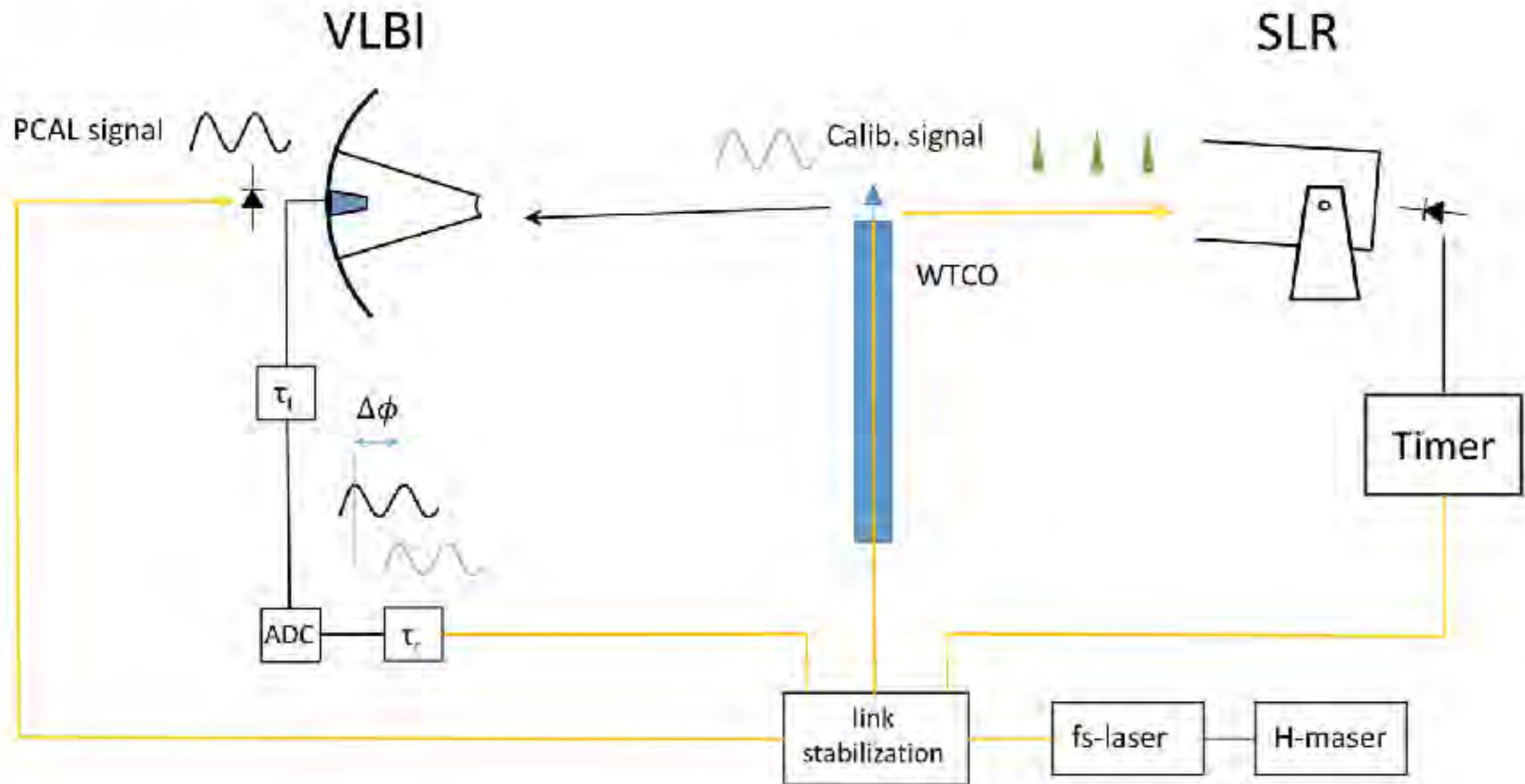


- star - configuration
- each link is individually stabilized
- all delays known
- electrical potential under control
- The central target WTCO is also referenced in time
- target measurements become much more involved

Note that there is a distinction between the optical and the electrical domain



# Technique independent Closure for Space Geodesy



## **SDSG Meeting 4. Oct. / 08:00 – 09:00 / Room 240**

**Draft Schedule – we will remain flexible until begin of meeting**

**- A few presentations:**

**Michael Steindorfer: ‘Simultaneous SD LR & LC of large re-entry target’**

**Daniel Kucharski: ‘Towards sat shape recognition with Graz SP Counting..’**

**James Bennet: ‘Analysis of close approach between Ja2 & Topex’**

**Michael Steindorfer: ‘Sat Tracer Program’; public; TLE / display /SDSG**

**- Discussions: As time available / as needed**

# Global Geodetic Observing System (GGOS)

- Provides a forum for the Services to inform and plan
- Primary task: work with the Services to maintain and improve the reference frame; work toward the 1mm accuracy station positions
- Project future network capability using simulations with anticipated network improvements
- Help find new partners (stations)
- Maintain the site requirements document
- Updating the GGOS 2020 document
- Project future network capability using anticipated network improvement
- Focus Areas
  - Reference Frame
  - Unified Height System (L. Sanchez)
  - Geohazards (J. LaBrecque)
  - Sea Level Change; Variability and Forecasting (T. Schoene)
  - Geodetic Space Weather (M. Schmidt)

